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THAT WHICH IS CLAIMED:

1. A structural member, comprising:

a first region characterized by comparatively high operational stress; and

a second region having a more refined grain structure than other portions of the structural member, said second region at least partially encompassing said first region to thereby selectively improve the strength, toughness and fatigue resistance of the structural member in said first region.

2. A structural member as defined in Claim 1 further comprising a threaded opening at least partially contained within said second region.

3. A structural member as defined in Claim 1 wherein the structural member is formed of materials selected from the group consisting of steel, stainless steel, magnesium, magnesium-based alloys, brass, copper, beryllium, beryllium-copper alloys, aluminum, aluminum-based alloys, aluminum-zinc alloys, aluminum-copper alloys, aluminum-lithium alloys, and titanium.

4. A structural member as defined in Claim 1 wherein the structural member has an I-shaped configuration having opposed end portions and a web interconnecting the end portions, and wherein said second region includes at least a portion of the web.

5. A structural member as defined in Claim 4 wherein said second region includes at least a portion of at least one of said opposed end portions.

6. A structural member as defined in Claim 1 wherein the structural member has a tubular configuration.

7. A structural member as defined in Claim 1 wherein the structural member defines a plurality of regions having refined grain structures, said regions being spaced apart and generally parallel.

8. A structural member as defined in Claim 1 wherein the structural member defines a first set of regions having refined grain structures and a second set of regions having refined grain structures, said first set of regions being spaced apart and generally parallel, said second set of regions being spaced apart and generally parallel, and wherein said first set of regions intersects said second set of regions to thereby define a plurality of containment zones.

9. A structural assembly, comprising:

a plurality of structural members, said plurality of structural members being secured together to form the structural assembly; and

wherein at least one of said plurality of structural members defines a first region characterized by comparatively high operational stress and a second region having a more refined grain structure than other portions of the structural member, said second region at least partially encompassing said first region to thereby selectively improve the strength, toughness and fatigue resistance of said at least one structural member in said first region.

10. A structural assembly as defined in Claim 9 wherein said at least one structural member defines a threaded opening at least partially contained within said second region.

11. A structural assembly as defined in Claim 9 wherein said plurality of structural members are formed of materials selected from the group consisting of steel, stainless steel, magnesium, magnesium-based alloys, brass, copper, beryllium, beryllium-copper alloys, aluminum, aluminum-based alloys, aluminum-zinc alloys, aluminum-copper alloys, aluminum-lithium alloys, and titanium.

12. A structural assembly as defined in Claim 9 wherein said at least one structural member has an I-shaped configuration having opposed end portions and a web interconnecting the end portions, and wherein said second region includes at least a portion of the web.

13. A structural assembly as defined in Claim 10 wherein said second region includes at least a portion of at least one of said opposed end portions.

14. A structural assembly as defined in Claim 9 wherein said at least one structural member has a tubular configuration.

15. A structural assembly as defined in Claim 9 wherein said at least one structural member defines a plurality of regions having refined grain structures, said regions being spaced apart and generally parallel.

16. A structural assembly as defined in Claim 1 wherein said at least one structural member defines a first set of regions having refined grain structures and a second set of regions having refined grain structures, said first set of regions being spaced apart and generally parallel, said second set of regions being spaced apart and generally parallel, and wherein said first set of regions intersects said second set of regions to thereby define a plurality of containment zones.

17. A structural assembly as defined in Claim 9 wherein said plurality of structural members are secured together to form the frame of an aircraft.

18. A structural member prepared by a process comprising the steps of:

securing the structural member to prevent movement;

identifying a region of the structural member having a comparatively high operational stress;

positioning a friction stir welding probe adjacent the region of high operational stress; and

thereafter, inserting a rotating friction stir welding probe through the outer surface of the structural member to locally refine the grain structure of the structural member within the region of high operational stress to thereby improve the strength, toughness and fatigue resistance of the structural member in the region.

19. A process as defined in Claim 18, further comprising casting the structural member in a pre-selected configuration prior to said securing step.

20. A process as defined in Claim 18, further comprising moving the rotating friction stir welding probe through the structural member along a path corresponding to the region of high operational stress after said inserting step.

21. A process as defined in Claim 18, further comprising machining the structural member to a corresponding pre-selected shape and thickness after said inserting step.

22. A process as defined in Claim 18, further comprising machining a threaded opening at least partially within the region of the structural member having a locally refined grain structure after said inserting step.

23. A process as defined in Claim 18, further comprising withdrawing the friction stir welding probe from the outer surface of the structural member to thereby define a threaded opening at least partially within the region of the structural member having a locally refined grain structure after said inserting step.

24. A process as defined in Claim 18, further comprising the step of precipitation hardening the structural member after said inserting step.

25. A process as defined in Claim 18, further comprising the step of attaching the structural member to other structural members to form the frame of an aircraft.

26. A structural member prepared by a process comprising the steps of:

securing the structural member to prevent movement;

identifying a region of the structural member having a comparatively high operational stress; and

thereafter, mixing the region of the structural member having a comparatively high operational stress with a rotating friction stir welding probe to locally refine the grain structure of the structural member within the region of high operational stress to thereby improve the strength, toughness and fatigue resistance of the structural member in the region.

27. A process as defined in Claim 26, wherein said mixing step comprises:

inserting a rotating friction stir welding probe through the outer surface of the structural member to locally refine the grain structure of the structural member within the region of high operational stress; and

thereafter, moving the rotating friction stir welding probe through the structural member along a path corresponding to the region of high operational stress.

28. A process as defined in Claim 26, further comprising machining the structural member to a corresponding pre-selected shape and thickness after said mixing step.

29. A process as defined in Claim 26, further comprising machining a threaded opening at least partially within the region of the structural member having a locally refined grain structure after said mixing step.

30. A process as defined in Claim 26, further comprising the step of precipitation hardening the structural member prior to said mixing step.

31. A process as defined in Claim 26, further comprising the step of attaching the structural member to other structural members to form the frame of an aircraft.